CSIR-UGC-NET (Chemical Sciences) - 27/12/2019

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CSIR-UGC-NET-DEC-2019 - Chemical Science (27-12-2019)

Q.21 – Q.60 MCQ, carry TWO marks each (for each wrong answer: –0.5).
You are required to Answer Maximum 35 Questions.

21. **The correct statement about the product formed when D-glucose is reacted with dilute HNO_3 is**

(a) the product is optically inactive

(b) the open chain structure of the product shows an IR absorption band at 1740 cm^{-1}

(c) the product shows a signal at δ 12 - 13 ppm in the ^{1}H-NMR spectrum

(d) the product gives a brick red precipitate upon treatment with Fehling's solution

22. **In a cubic crystal, what will be the interplanar distance of (111) planes showing a first order reflection at 2θ of 60° when Cu K_α-X rays $(\lambda = 1.54\ Å)$ were used?**

(a) 0.77 Å (b) 1.54 Å (c) 2.31 Å (d) 3.08 Å

23. **Which of the following aqueous solutions will have the lowest mean ionic activity coefficient?**

(a) 1.0 mmol kg^{-1} NaCl (b) 5.0 mmol kg^{-1} NaCl

(c) 1.0 mmol kg^{-1} $MgCl_2$ (d) 5.0 mmol kg^{-1} $MgCl_2$

24. **The fraction of ^{14}C remaining in an 11,460 years old sample is**
(Half-life for ^{14}C is 5730 years),

(a) 0.15 (b) 0.20 (c) 0.25 (d) 0.30

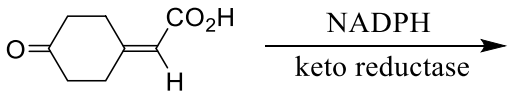
25. **The correct order of the chemical shift values of the methyl group protons in the following compounds is**

(i)	(ii)	(iii)	(iv)
CH_3NO_2	CH_3CN	CH_3Cl	$PhCOCH_3$

(a) ii > iii > i > iv (b) i > iii > iv > ii

(c) i > ii > iii > iv (d) iii > i > iv > ii

26. **The major product formed in the following reaction is optically active because it possesses**



(a) chiral centre (b) chiral axis (c) chiral plane (d) helical chirality

27. **The first ionisation potential of three successive elements in the periodic table are 1086, 1402 and 1314 kJ mol^{-1}, respectively. These elements are**

(a) B, C, N (b) C, N, O (c) N, O, F (d) O, F, Ne

28. **The number of electrons transferred for the oxidation of water by the photosystem-II is**

(a) 2 (b) 4 (c) 6 (d) 8

29. **The process in which the temperature of an ideal gas does NOT change, is**

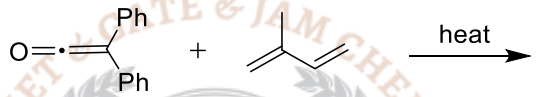
(a) Free expansion

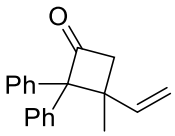
(b) Adiabatic reversible expansion

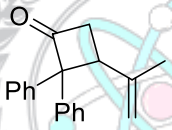
(c) Adiabatic expansion against 1 bar pressure

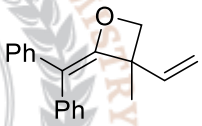
(d) Sudden compression

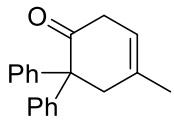
30. **The major product formed in the following reaction is**



(a) 

(b) 

(c) 

(d) 

31. **The set of compounds, all having polymeric structure at room temperature, is**

(a) AlF_3, GaF_3 and SnF_4 (b) AsF_5, GeF_4 and SiF_4

(c) KH, NaH and MgH_2 (d) ClO_2, BrO_2 and SiO_2

32. **To explain the experimental magnetic moment of the complex at room temperature, the orbital contribution is NOT required for**

(a) $[Co(H_2O)_6]^{2+}$ (b) $[NiCl_4]^{2-}$ (c) $[Cr(CN)_6]^{4-}$ (d) $[Ni(en)_3]^{2+}$

33. **The correct order of stretching frequency (ν_{SO}) (M is metal), is**

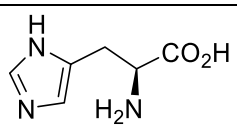
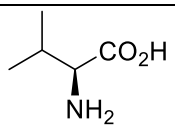
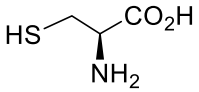
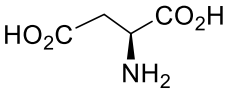
(a) $M-S(O)Me_2 > Me_2S(O) > M-OSMe_2$

(b) $Me_2S(O) > M-S(O)Me_2 > M-OSMe_2$

(c) $Me_2S(O) > M-OSMe_2 > M-S(O)Me_2$

(d) $M-OSMe_2 > Me_2S(O) > M-S(O)Me_2$

34. **The correct order of elution of amino acids (i - iv) with a buffer of pH 4 from a column containing anion exchange resin is**

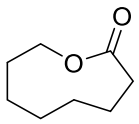
i	ii	iii	iv
			

(a) i > ii > iii > iv (b) ii > i > iii > iv

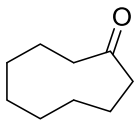
(c) iv > iii > ii > i (d) i > iii > ii > iv

35. **The correct order of the C=O stretching frequency in the following compounds**

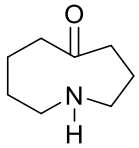
i



ii



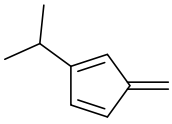
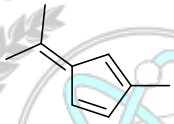
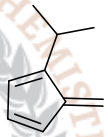
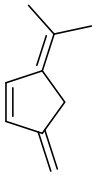
iii



(a) i > ii > iii (b) ii > i > iii

(c) i > iii > ii (d) iii > ii > i

36. **The most acidic hydrocarbon among the following is**

(a)  (b)  (c)  (d) 

37. **A molecule is excited at x_1 nm, λ_{max} of fluorescence and phosphorescence bands are observed at x_2 nm and x_3 nm, respectively. In most of the cases, the correct statement among the following is**

(a) $x_1 > x_2 > x_3$ (b) $x_2 > x_1 > x_3$

(c) $x_1 < x_2 < x_3$ (d) $x_1 < x_3 < x_2$

38. **Among the following, the complex easiest to reduce is**

(a) $[Fe(phen)_3]^{3+}$ (b) $[Fe(H_2O)_6]^{3+}$ (c) $[Fe(CN)_6]^{3-}$ (d) $[Fe(EDTA)]^{-}$

39. **The correct order of solubility of silver halides in liquid ammonia is**

(a) AgF < AgCl < AgBr < AgI

(b) AgCl < AgI < AgBr < AgF

(c) AgI < AgCl < AgF < AgBr

(d) AgI < AgBr < AgCl < AgF

40. **Repeated measurements of the melting point of a solid gave values, 195, 205 and 210 °C. The actual melting point of the solid is 200 °C. The % of relative error in the average experimental result is close to**

(a) 2.7 (b) 1.7 (c) 1.2 (d) 2.2

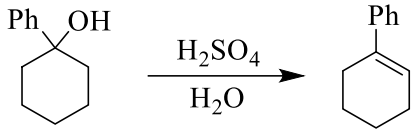
41. **The correct pair of ions for which only the ground state J level is populated at room temperature, is**

(a) $Eu^{3+}$and Sm^{3+} (b) $Sm^{3+}$and Ce^{3+} (c) $Ce^{3+}$and Eu^{3+} (d) $Dy^{3+}$and Ce^{3+}

42. **If the units of rate constant are $M^{-1/2}s^{-1}$, the order of the reaction would be**

(a) 1 (b) 1.5 (c) 2 (d) 2.5

43. **The reaction that will show a non-zero deuterium kinetic isotope effect is**

[P] 

[Q] 

[R] 

(a) only P (b) only Q (c) only R (d) both P and R

44. **The total number of stereoisomers (including enantiomeric pairs) for an octahedral complex Ma_3bcd is _____ (where a, b, c and d are monodentate ligands)**

(a) 3 (b) 4 (c) 5 (d) 6

45. **Which among the following complexes obey 18-electron rule?**

P	Q	R
$Fe_2(CO)_9$	$Cr(NO)_4$	$[Mo(CN)_6]^{4-}$

(a) P only (b) Q and R (c) P and Q (d) P and R

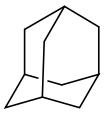
46. **H_2O_2 belongs to the point group**

(a) C_1 (b) C_2 (c) C_{2v} (d) C_{2h}

47. **The ratio of adsorption and desorption rate constants of a gas on metal surface is $0.2\ kPa^{-1}$ at 25 °C. Assuming the Langmuir type isotherm, the pressure at which 50 % surface coverage will take place, is**

(a) 5 kPa (b) 50 kPa (c) 2.5 kPa (d) 25 kPa

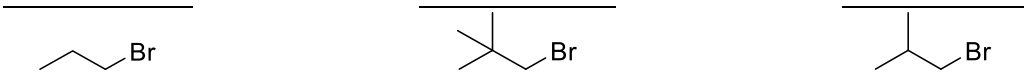
48. **The number of signals observed in the proton decoupled ^{13}C-NMR spectrum of the following compound is**



(a) 2 (b) 3 (c) 4 (d) 5

49. **The rate of reactions for the following halides with NaI would vary as**

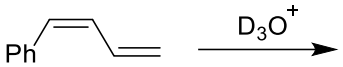
i	ii	iii
_____	_____	_____

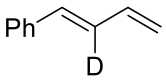


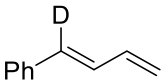
(a) i > ii > iii (b) ii > i > iii

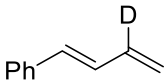
(c) i > iii > ii (d) iii > ii > i

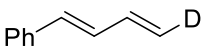
50. The major product formed in the following reaction is



(a) 

(b) 

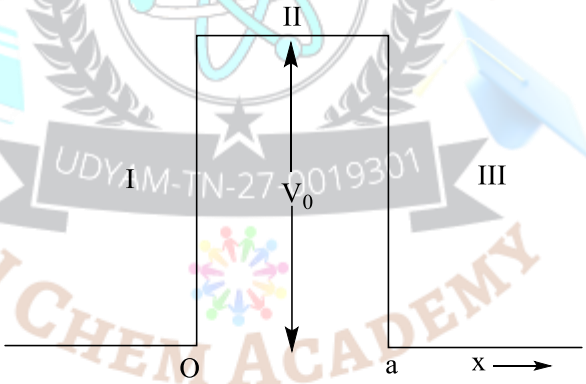
(c) 

(d) 

51. The activation energy of a bimolecular reaction is $104\ \text{kJ mol}^{-1}$ at $300\ \text{K}$. Its enthalpy of activation (in kJ mol^{-1}) would be closest to__ ($R = 8.314\ \text{JK}^{-1}\text{mol}^{-1}$)

(a) 9.90 (b) 99.0 (c) 0.99 (d) 0.099

52. As shown in the figure below, for a particle incident on the barrier from the left, the wave function in regions I and III is given by



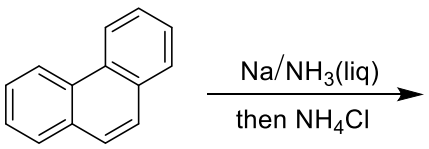
$\psi_I = A_1 e^{ik_1 x} + Be^{-ik_3 x}$ and $\psi_{III} = A_2 e^{ik_2 x}$

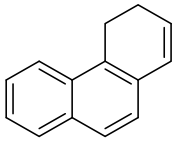
The correct statement among the following is

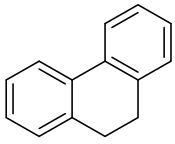
(a) $|A_1| \geq |A_2|$ and $k_1 = k_2$ (b) $|A_1| < |A_2|$ and $k_1 = k_2$

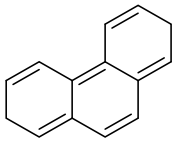
(c) $|A_1| \geq |A_2|$ and $k_1 > k_2$ (d) $|A_1| < |A_2|$ and $k_1 < k_2$

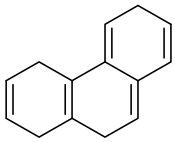
53. The major product formed in the following reaction is



(a) 

(b) 

(c) 

(d) 

54. **The compound that is used as anti-HIV drug is**

(a) Zidovudine (b) Adefovir (c) Amiodipine (d) Taxol

55. **Identify the metal carbonyl(s) which is/are isostructural to $Os_3(CO)_{12}$ at 298 K from the following**

$Fe_3(CO)_{12}$	$Fe_2Ru(CO)_{12}$	$FeRu_2(CO)_{12}$	$Ru_3(CO)_{12}$
P	**Q**	**R**	**S**

(a) P only (b) R and S (c) Q, R and S (d) P, Q and R

56. **Which of the following is an example of a disproportionation reaction?**

(a) $H_2O_2 + SO_2 \longrightarrow H_2SO_4$

(b) $H_2O_2 + HOCl \longrightarrow H_3O^+ + Cl^- + {}^1O_2{}^*$

(c) $H_2O_2 + O_3 \longrightarrow H_2O + 2O_2$

(d) $H_2O_2 \longrightarrow H_2O + 1/2\ O_2$

57. **For a closed system, in the absence of non-PV work, the state function which gives rise to the Maxwell relation $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_p$ is**

a) A (b) G (c) U (d) H

58. **The wave function that correctly describes the ground state of the H_2 molecules, in terms of the two atomic orbitals s_a and s_b and the spin functions α and β, is**

(a) $[s_a(r_1)s_b(r_2) + s_a(r_2)s_b(r_1)][\alpha(1)\beta(2) + \alpha(2)\beta(1)]$

(b) $[s_a(r_1)s_b(r_2) + s_a(r_2)s_b(r_1)][\alpha(1)\beta(2) - \alpha(2)\beta(1)]$

(c) $[s_a(r_1)s_b(r_2) - s_a(r_2)s_b(r_1)][\alpha(1)\beta(2) + \alpha(2)\beta(1)]$

(d) $[s_a(r_1)s_b(r_2) - s_a(r_2)s_b(r_1)][\alpha(1)\beta(2) - \alpha(2)\beta(1)]$

59. **According to the Hammond postulate, the correct statement among the following is**

(a) The transition state of an endothermic reaction resembles the starting material

(b) The transition state of an exothermic reaction resembles the product

(c) The transition state of an endothermic reaction resembles the product

(d) The transition state in an endothermic as well as exothermic reaction does not bear any resemblance to either the starting material or the product

60. **The compound $[OCNCO]^+[Sb_3F_{16}]^-$ has C−N−C angle 131° and C−O bond length**

112 pm. The Lewis structure consistent with this data has formal charge of

(a) −1 on N (b) +1 on C (c) −1 on C (d) +1 on N

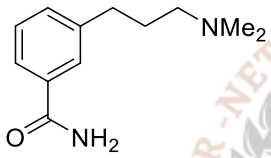
Q.61 – Q.120 MCQ, carry FOUR marks each (for each wrong answer: –1).
You are required to Answer Maximum 25 Questions.

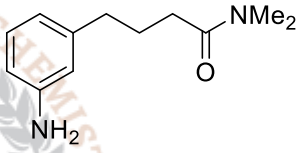
61. An organic compound shows following spectral data:

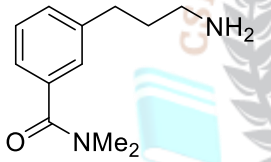
^{1}H-NMR : $1.90(\text{quintet}, 2H), 2.18(t, 2H), 2.55(t, 2H), 2,85(s, 3H), 2.95(s, 3H), 4.00(\text{br s}, 2H), 6.28(d, J = 8\ \text{Hz}, 1H), 6.35(s, 1H), 6.48(d, J = 8\ \text{Hz}, 1H), 6.98(t, J = 8\ \text{Hz}, 1H)$

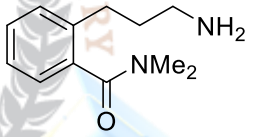
m/z : $206\ (M^+), 106, 87.$

The structure of the compound amongst the following is

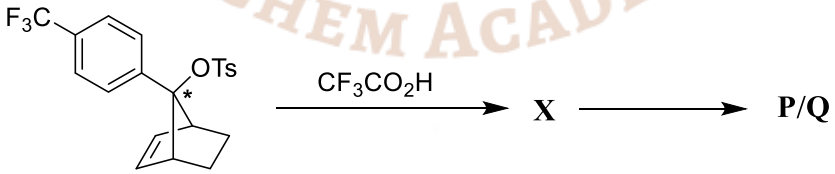
(a) 

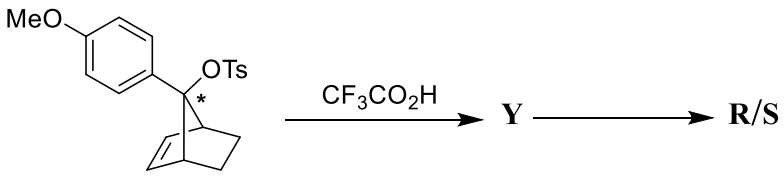
(b) 

(c) 

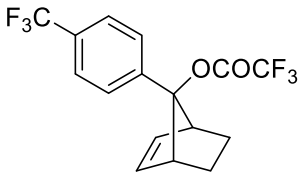
(d) 

62. The reactions I and II proceed through the intermediates [X] and [Y] to furnish the products P/Q and R/S, respectively. The labelled carbons resonate at δ 81 and 220 ppm, in the corresponding intermediates [X] and [Y] in their ^{13}C-NMR spectra

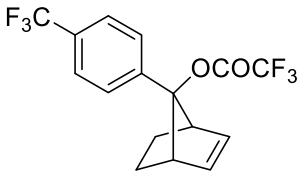
I. 

II. 

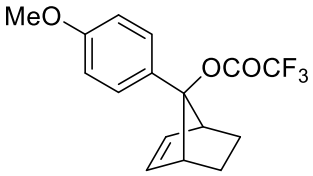
Products



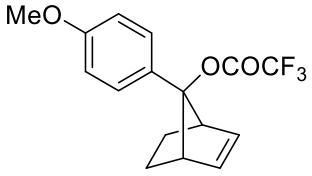
P



Q



R

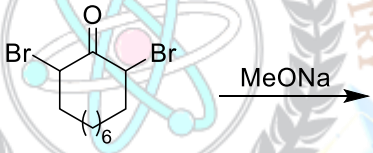


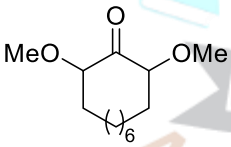
S

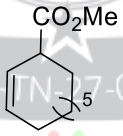
The products in the reactions I and II are

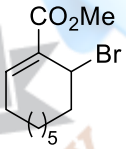
(a) I : P; II : R (b) I : P; II : R and S (c) I : P and Q; II : R and S (d) I : Q; II : S

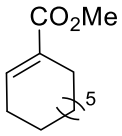
63. The major product formed in the following reaction is



(a) 

(b) 

(c) 

(d) 

64. The increasing order of autoprotolysis of H_3PO_4, H_2SO_4, HF and CH_3COOH is

(a) $CH_3COOH < HF < H_2SO_4 < H_3PO_4$

(b) $CH_3COOH < HF < H_3PO_4 < H_2SO_4$

(c) $HF < CH_3COOH < H_3PO_4 < H_2SO_4$

(d) $H_2SO_4 < H_3PO_4 < CH_3COOH < HF$

65. Given the standard electrode potentials,

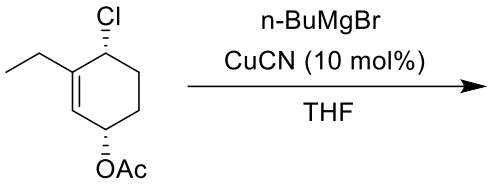
$$Fe^{3+}_{(aq)} + e^- \longrightarrow Fe^{2+}_{(aq)} \quad ; \quad E^\circ = 0.77\ V$$

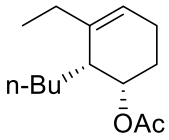
$$Fe^{2+}_{(aq)} + 2e^- \longrightarrow Fe_{(s)} \quad ; \quad E^\circ = -0.445\ V$$

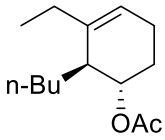
the value of E°(in V) for the reaction $Fe^{3+}_{(aq)} + 3e^- \longrightarrow Fe_{(s)}$ is closest to

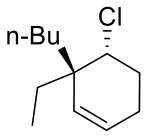
(a) −0.04 (b) −0.4 (c) 0.325 (d) 1.215

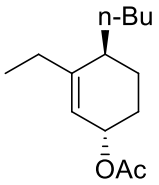
66. The major product formed in the following reaction is



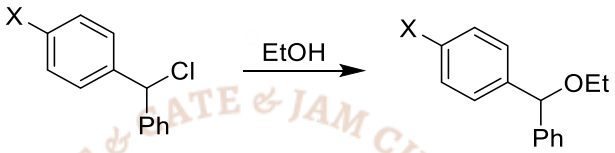
(a) 

(b) 

(c) 

(d) 

67. The true statement regarding the following reaction is



(ρ is Hammett reaction constant)

(a) The reaction proceeds via S_N2 mechanism and has a large negative ρ value

(b) The reaction proceeds via S_N1 mechanism and has a large positive ρ value

(c) The reaction proceeds via S_N2 mechanism and has a large positive ρ value

(d) The reaction proceeds via S_N1 mechanism and has a large negative ρ value

68. For the inner-sphere electron transfer reaction between $[Co(NH_3)_5X]^{2-}$ ($X = F^-, Br^-, I^-$) and $[Cr(H_2O)_6]^{2+}$, the rates of the reaction depend on the 'X' in the order

(a) $F^- > Br^- > I^-$ (b) $I^- > F^- > Br^-$

(c) $F^- > I^- > Br^-$ (d) $I^- > Br^- > F^-$

69. The highest occupied molecular orbital of BeH_2 is,

(s_a and s_b are the 1s orbitals of the two hydrogen atoms, s_0, p_x, p_y and p_z are the atomic orbitals of the second shell of Be)

(a) $s_a + s_b + s_0$ (b) $s_a + s_b + p_z$ (c) $s_a - s_b + p_z$ (d) $s_a + s_b - s_0$

70. The number of vibrational modes of pyridine that will NOT show IR activity is

C_{2v}	E	C_2	σ_v^{xz}	σ_v^{yz}	
A_1	1	1	1	1	z, x^2, y^2, z^2
A_2	1	1	−1	−1	R_z, xy
B_1	1	−1	1	−1	x, R_y, xz
B_2	1	−1	−1	1	y, R_x, yz

(a) 0 (b) 3 (c) 4 (d) 7

71. **The extent of dissociation, α, of the reaction**

$$A_{2(g)} \rightleftharpoons 2A_{(g)} \text{ is given by } \alpha = [1 + (4p/Kp^0)]^{-1/2}$$

The correct statement among the following is

(a) K is dependent on pressure

(b) Amount of A_2 and A do not depend on pressure

(c) As p is increased, α decreases in accordance with Le Chatelier's principle

(d) As p is increased, α increases in accordance with Le Chatelier's principle

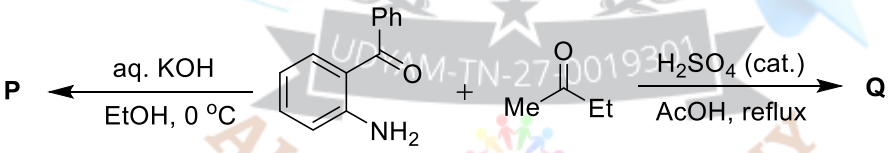
72. **The (110) reflection of the X-ray diffraction pattern of a monatomic metal crystallizing in the body-centered cubic structure appears with $d = 3.0$ Å. The nearest neighbouring atoms in the crystal are separated (in Å) by**

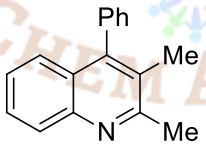
(a) 1.5 (b) 3.0 (c) 3.67 (d) 4.24

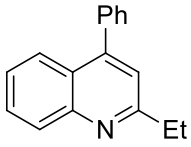
73. **The number of O–O stretching frequencies (ν_{O-O}) observed in Raman spectrum when deoxyhemerythrin is exposed to excess O_2 containing equal amounts of $^{16}O_2$, $^{18}O_2$ and ^{16}O-^{18}O, is**

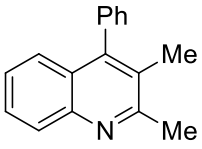
(a) 4 (b) 3 (c) 2 (d) 1

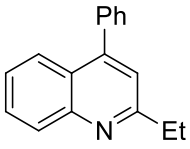
74. **The major products P and Q in the following reactions are**

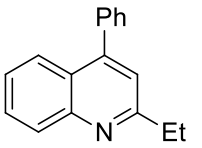


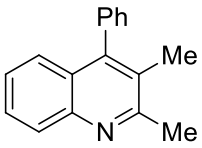
(a) P = Q = 

(b) P = Q = 

(c) P = 

Q = 

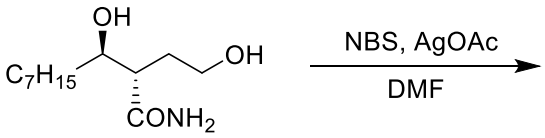
(d) P = 

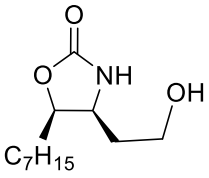
Q = 

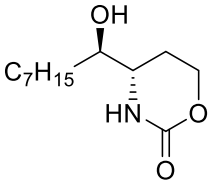
75. **The value μ_{eff} (BM) including spin-orbit coupling contribution, for $[Ni(NH_3)_6]^{2+}$ is ($\Delta_o = 12000\ cm^{-1}$, λ (spin-orbit coupling constant) = $-300\ cm^{-1}$)**

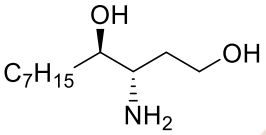
(a) 3.11 (b) 2.83 (c) 2.97 (d) 2.80

76. The major product formed in the following reaction is



(a)


(b)


(c)


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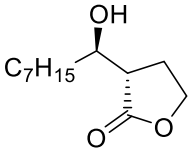


77. In bis(benzene)chromium an additional electron is delocalized onto any one of the benzene rings. The number of hyperfine signals in high resolution EPR spectrum of this system is ($^{52}Cr, I = 0$; ignore other isotopes of Cr. $^{1}H, I = ½$)

(a) 6 (b) 7 (c) 12 (d) 14

78. A polyesterification reaction is stopped after 50% of monomers are consumed. The number average degree of polymerisation of the resulting polyester is

(a) 5 (b) 2 (c) 3 (d) 0.5

79. The ratio of rotational partition functions of HCl and DCl $\left[\frac{q^R(HCl)}{q^R(DCl)}\right]$ at any temperature is closest to

(a) 2 (b) 0.67 (c) 0.5 (d) 0.25

80. ^{31}P-NMR spectrum of P_4S_3 ($^{31}P, I = ½$ and $^{32}S, I = 0$) has

(a) two signals (a doublet and a quartet) (b) four signals (all doublets)

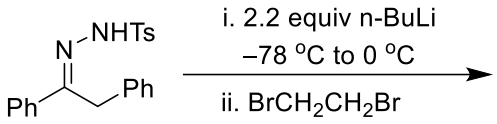
(c) one signal only (d) three signals

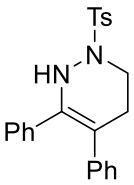
81. Reduction potentials of plastocyanin ('P1'), myoglobin ('P2'), cytochrome c ('P3') and cytochrome P450 ('P4') are $+370, +50, +260$ and -300 mV respectively. The correct order for spontaneous electron transfer among these four proteins is

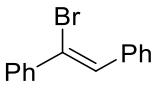
(a) P1 → P3 → P2 → P4 (b) P4 → P2 → P3 → P1

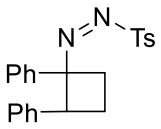
(c) P2 → P3 → P4 → P1 (d) P3 → P4 → P1 → P2

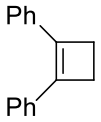
82. The major product formed in the following reaction is



(a) 

(b) 

(c) 

(d) 

83. The correct set of relations among the following, for one component system is

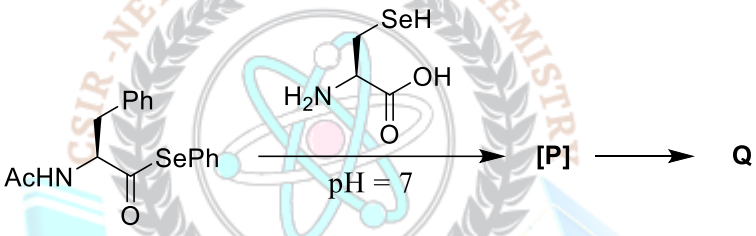
(a) $\left(\frac{\partial \mu}{\partial T}\right)_p = -S_m$ and $\left(\frac{\partial \mu}{\partial p}\right)_T = -V_m$

(b) $\left(\frac{\partial \mu}{\partial T}\right)_p = -S_m$ and $\left(\frac{\partial \mu}{\partial p}\right)_T = V_m$

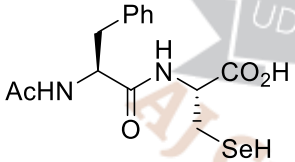
(c) $\left(\frac{\partial \mu}{\partial T}\right)_p = S_m$ and $\left(\frac{\partial \mu}{\partial p}\right)_T = -V_m$

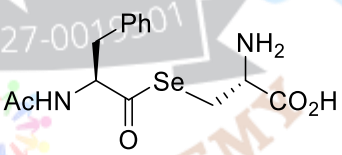
(d) $\left(\frac{\partial \mu}{\partial T}\right)_p = S_m$ and $\left(\frac{\partial \mu}{\partial p}\right)_T = V_m$

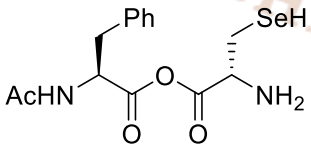
84. The intermediate [P] and major product Q formed in the following reaction are

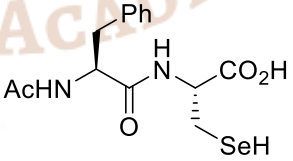


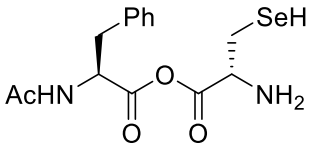
[P] Q

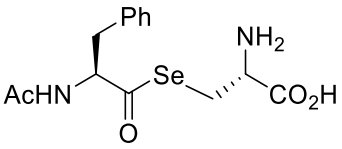
(a) 

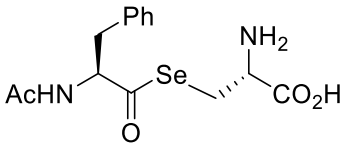
; 

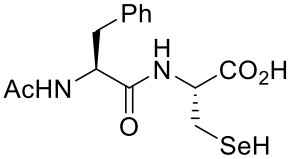
(b) 

; 

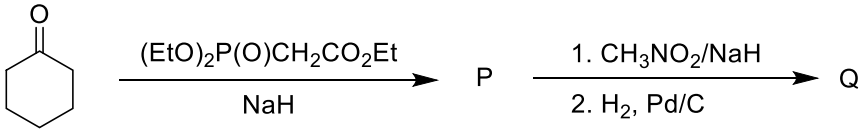
(c) 

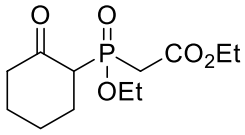
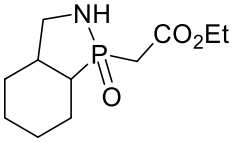
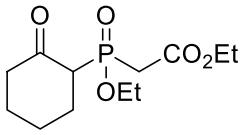
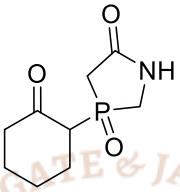
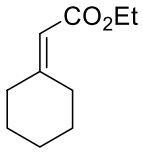
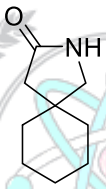
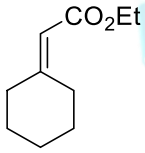
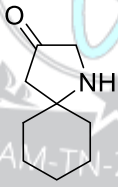
; 

(d) 

; 

85. The major products P and Q formed in the following reaction sequence are



	P	Q
(a)		
(b)		
(c)		
(d)		

86. **The set in which each of the species facilitates the formation of $[HF_2]^-$ on reaction with HF is**

(a) SbF_5, SF_4 and ClF_3 (b) AsF_5, ClF_3 and RCH_2OH

(c) SbF_5, AsF_5 and XeF_6 (d) SF_4, ClF_3 and RCH_2OH

87. **The pH electrodes are calibrated with the slope of the cell potential to pH. By what factor does the cell potential change when pH is doubled at a given temperature?**

(a) 0.5 (b) 1 (c) 2 (d) 3

88. **A particle in a one-dimensional box is in a state given by**

$$\psi = \left(\frac{2}{L}\right)^{1/2}\left[\sin\frac{\pi x}{L} + 2\sin\frac{2\pi x}{L}\right]$$

The probability that the measured energy, is $\frac{4h^2}{8mL^2}$, is

(a) 0.50 (b) 0.66 (c) 0.75 (d) 0.80

89. **For a first order phase transition,**

(a) the heat capacity is infinite at the transition temperature

(b) the heat capacity is continuous and finite at the transition temperature

(c) the heat capacity is zero at the transition temperature

(d) the heat capacity is discontinuous and finite at the transition temperature

90. Based on the MO diagram of $HS^{\cdot}$ (sulfanyl radical), choose the correct statement(s) (the energies of the relevant atomic orbitals are:

1s(H)	3s(S)	3p(S)
−13.6 eV	−20.7 eV	−11.7 eV

[P] σ-bond formed will have more 3p(S) character

[Q] σ-bond will be formed between 1s(H) and 3p(S)

[R] σ-bond will be formed between 1s(H) and 3s(S)

[S] The unpaired electron will reside in the non-bonded p orbital

(a) Q and S (b) P, Q and S (c) R and S (d) P only

91. A gas molecule B reacts with a diatomic molecule A_2 dissociatively adsorbed on a metal surface. The rate of formation of product is

(p_A and p_B are the partial pressures of A_2 and B, respectively. k_r is the rate constant of reaction between A_2 and B. α is the ratio of rate constant for adsorption and desorption of A_2)

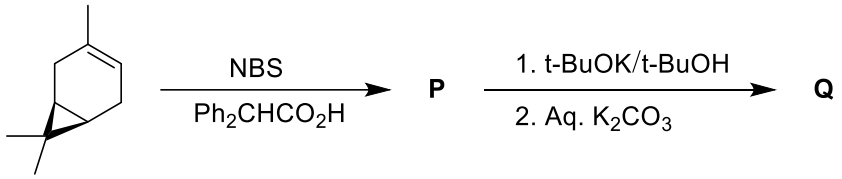
(a) $k_r p_A(\alpha p_B)^{1/2}/(1+(\alpha p_A)^{1/2})$ (b) $k_r p_B(\alpha p_A)^{1/2}/(1+(\alpha p_A)^{1/2})$

(c) $k_r p_A(\alpha p_B)^{1/2}/(1+(\alpha p_B)^{1/2})$ (d) $k_r \alpha p_A p_B/(1+\alpha p_B)$

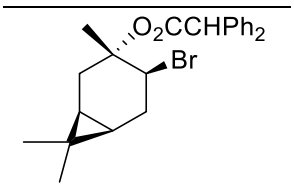
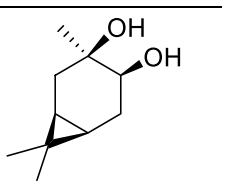
92. For a unimolecular gas phase reaction A ⟶ P, the effective rate constants at two different initial concentrations but at the same temperature are $2\times10^{-2}\ s^{-1}$ and $4\times10^{-3}\ s^{-1}$ at concentrations of 5×10^{-3} mol dm^{-3} and 1×10^{-3} mol dm^{-3}, respectively. The rate constant (in $dm^3 mol^{-1} s^{-1}$) for the activation step is

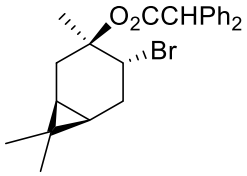
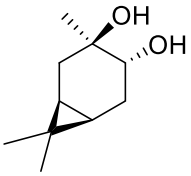
(a) 2.0 (b) 4.0 (c) 6.0 (d) 8.0

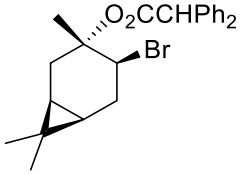
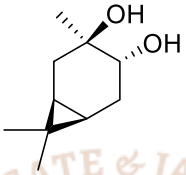
93. The major products P and Q formed in the following reaction sequence are

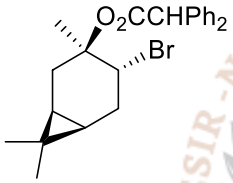
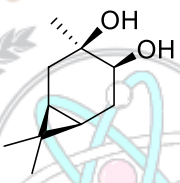


P Q

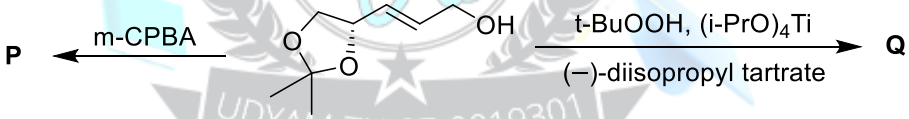
(a)  ; 

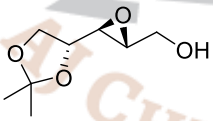
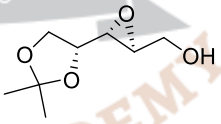
(b)  ; 

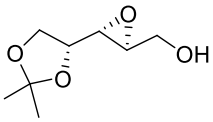
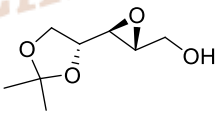
(c)  ; 

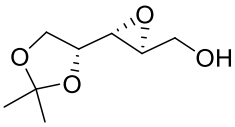
(d)  ; 

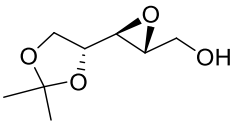
94. The major products P and Q formed in the following transformations are



(a) P =  Q = 

(b) P =  Q = 

(c) P = Q = 

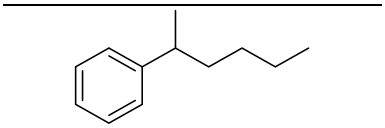
(d) P = Q = 

95. The Franck-Condon activity of two vibrational modes of a polyatomic molecule of C_2v point group belonging to the irreducible representations A_1 and A_2 are, respectively, (frequencies do not change upon electronic excitation)

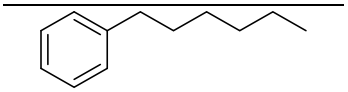
(a) Zero, Non-zero (b) Zero, Zero (c) Non-zero, Non-zero (d) Non-zero, Zero

96. Base peaks for isomers X and Y in the mass spectra are due to the following ionic species

X



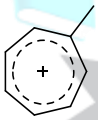
Y



(a) X = Y = 

(b) X = Y = 

(c) X =  Y = 

(d) X =  Y = 

97. The ground state term symbol for Ho^{3+} ion $(4f^{10})$ is

(a) $^5I_8$ (b) $^4I_{9/2}$ (c) $^4I_{15/2}$ (d) $^5H_{15/2}$

98. The correct order of d-orbital splitting energies (Δ_o) of the following is

$[Cr(CN)_6]^{3-}$ (I) $[Cr(H_2O)_6]^{3+}$ (II) $[CrCl_6]^{3-}$ (III)

(a) I > II > III (b) I > III > II

(c) II > III > I (d) III > II > I

99. Consider the reaction

$$A + B \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} C \xrightarrow{k_2} D$$

The values of activation energies for the individual steps are:

$E_\alpha[A + B \longrightarrow C] = 120\ kJ\ mol^{-1}$; $E_\alpha[C \longrightarrow A + B] = 240\ kJ\ mol^{-1}$;

$E_\alpha[C \longrightarrow D] = 80\ kJ\ mol^{-1}$;

If the overall rate constant is $k = \frac{k_1 k_2}{k_{-1}}$, the effect of increase in temperature is

(a) Rate of formation of D will increase

(b) Rate of formation of D will decrease

(c) No effect on rate of formation of D

(d) Rate of formation of C will decrease

100. **Energy of an isotopic three-dimensional Harmonic Oscillator is equal to $\frac{5}{2}h\nu$. The wavefunction and the degeneracy of this state are given by,**

(N is the normalization constant and $\alpha = \left(\frac{h^2}{mk}\right)^{1/4}$ with m being the mass and k the force constant of the oscillator)

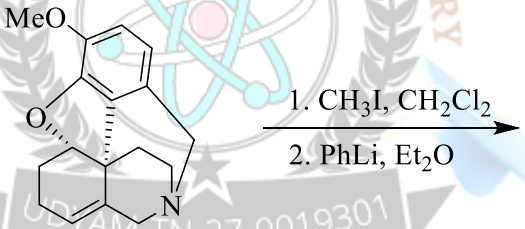
(a) $Ne^{-(x^2+y^2+z^2)/2\alpha^2}, 1$

(b) $Nxe^{-(x^2+y^2+z^2)/2\alpha^2}, 3$

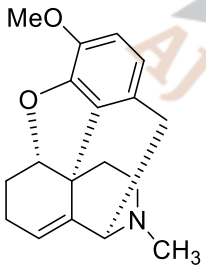
(c) $Nxye^{-(x^2+y^2+z^2)/2\alpha^2}, 1$

(d) $Nxyze^{-(x^2+y^2+z^2)/2\alpha^2}, 3$

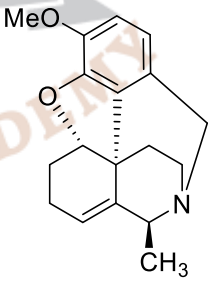
101. **The major product formed in the following transformation is**



(a)



(b)



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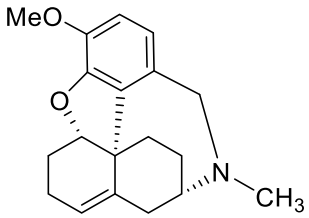
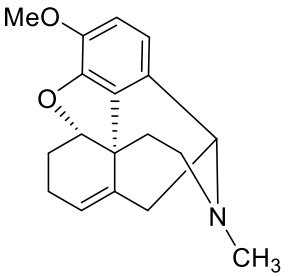


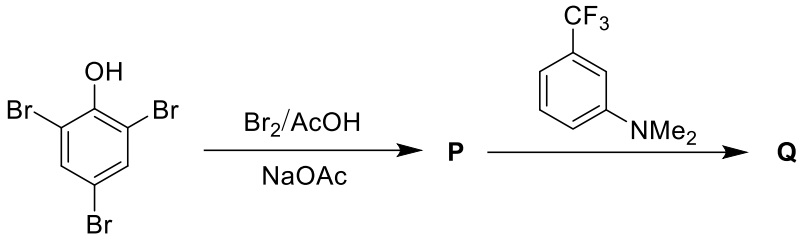
(d)

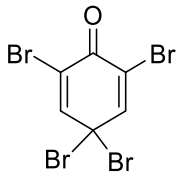
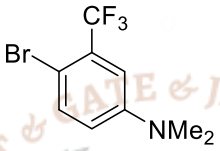
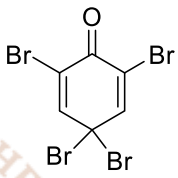
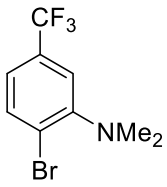
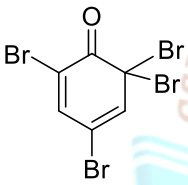
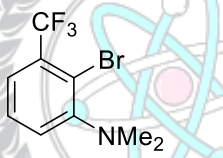
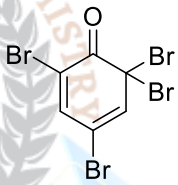
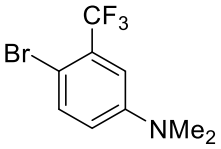


102. **The ground state wave function of a harmonic oscillator is $C_0 e^{-\omega x^2/2}$. If an external perturbation $V = -x$ is imposed on the system, the first order correction to the energy (E_0^1) is**

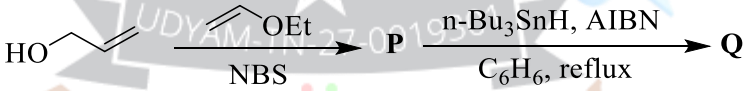
(a) $-\frac{\hbar\omega}{4}$ (b) 0 (c) $\frac{\hbar\omega}{4}$ (d) $C_0^2\frac{\hbar\omega}{4}$

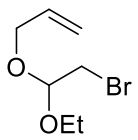
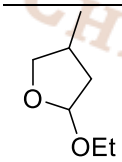
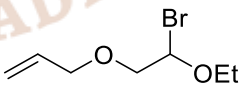
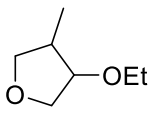
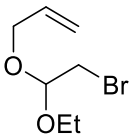
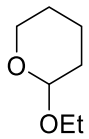
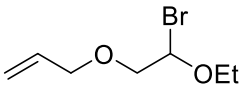
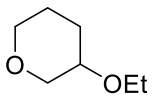
103. The major products P and Q in the following reaction sequence are



	P	Q
(a)		
(b)		
(c)		
(d)		

104. The major products P and Q in the following reaction sequence are

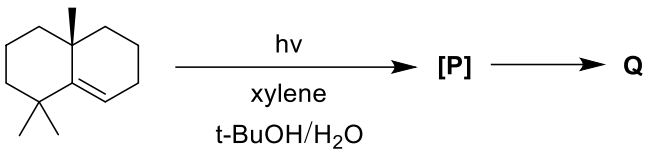


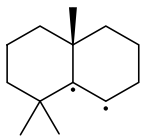
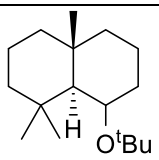
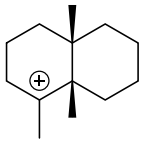
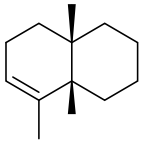
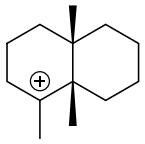
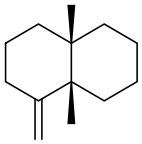
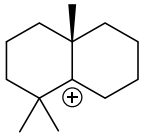
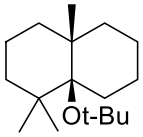
	P	Q
(a)		
(b)		
(c)		
(d)		

105. The diffusion-controlled rate constant (in units of $dm^3s^{-1}mol^{-1}$) at 25 °C for a species in a solvent with viscosity 1.00×10^{-3} kg $m^{-1}s^{-1}$ is close to

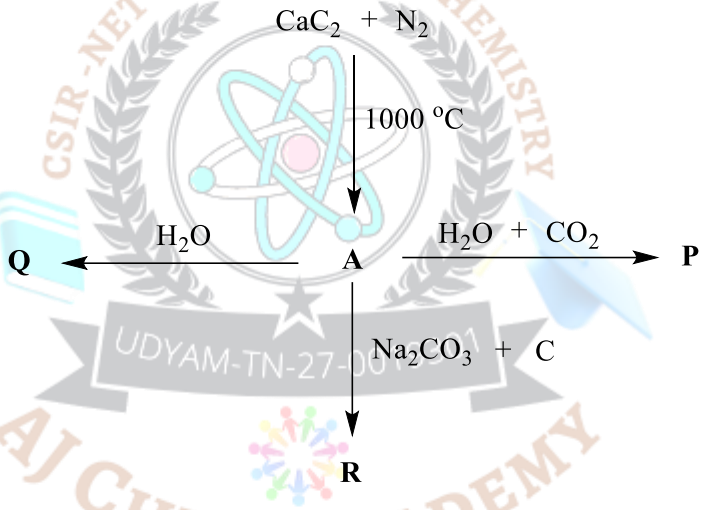
(a) 19.8×10^9 (b) 6.6×10^9 (c) 2.3×10^6 (d) 6.6×10^3

106. One of the intermediate [P] and the major product Q formed in the following reaction are



	[P]	Q		[P]	Q
(a)			(b)		
(c)			(d)		

107. For the following reactions, P, Q and R respectively, are



(a) $NH_2C(O)NH_2$, NH_2CN and Na_2NCN (b) NH_2CN, NH_3 and NaN_3

(c) NH_3, $NH_2C(O)NH_2$ and Na_2NCN (d) $NH_2C(O)NH_2$, NH_3 and NaCN

108. The complex(es) which do(es) NOT release alkene is/are

X. $[TiCl_2(CH_2CMe_3)_2]$

Y. 

Z. $[(\eta^5\text{-}C_5H_5)_2Ta(CH_2CH_2CH_2CH_3)_3]$

(a) X only (b) X and Y (c) X and Z (d) Y and Z

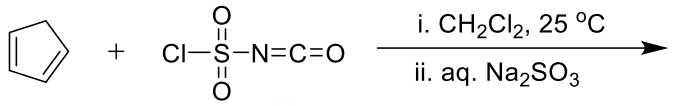
109. Difference between the first Stokes and anti-Stokes transitions of a diatomic molecule in rotational Raman spectrum is 24 cm^{-1}. The separation (in cm^{-1}) between adjacent lines in pure rotational spectrum of the molecule is

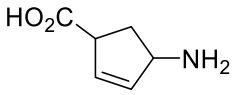
(a) 2 (b) 4 (c) 12 (d) 24

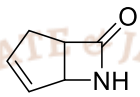
110. The depth of the potential energy well of a polyatomic molecule is $20000\ cm^{-1}$. The molecule has four normal modes of vibration $\nu_1(1000\ cm^{-1}), \nu_2(2000\ cm^{-1}), \nu_3(3000\ cm^{-1})$ and $\nu_4(4000\ cm^{-1})$. The dissociation energy of the molecule is $18000\ cm^{-1}$. The dissociation takes place along the normal mode

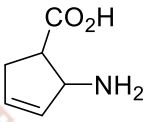
(a) ν_1 (b) ν_2 (c) ν_3 (d) ν_4

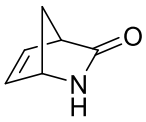
111. The major product formed in the following reaction is



(a) 

(b) 

(c) 

(d) 

112. In the given reaction,

$$[M(H_2{}^{16}O)_6]^{n+} + H_2{}^{18}O \underset{}{\overset{k}{\rightleftharpoons}} [M(H_2{}^{16}O)_5(H_2{}^{18}O)]^{n+} + H_2{}^{16}O$$

Where, M is Cu^{2+}, Mn^{2+}, V^{2+} and Cr^{3+}

The correct order for rate of water exchange (k) is

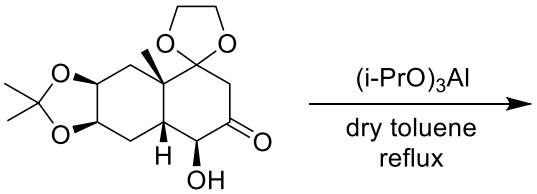
(a) $Cu^{2+} > Mn^{2+} > V^{2+} > Cr^{3+}$

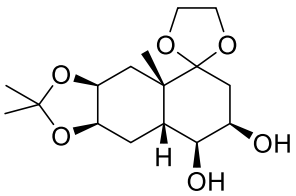
(b) $Mn^{2+} > V^{2+} > Cr^{3+} > Cu^{2+}$

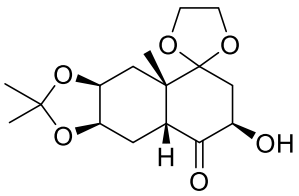
(c) $V^{2+} > Cu^{2+} > Cr^{3+} > Mn^{2+}$

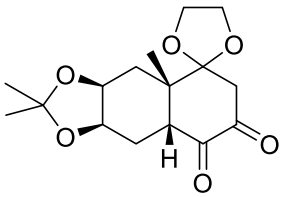
(d) $Cr^{3+} > Mn^{2+} > Cu^{2+} > V^{2+}$

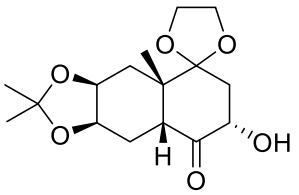
113. The major product formed in the following reaction is



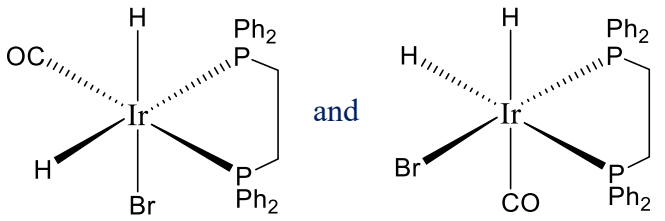
(a) 

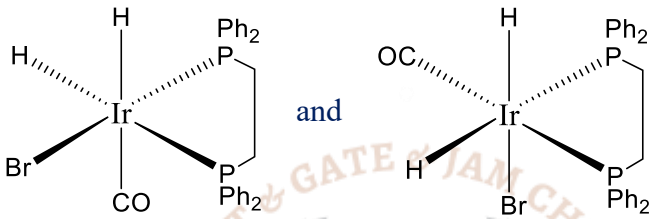
(b) 

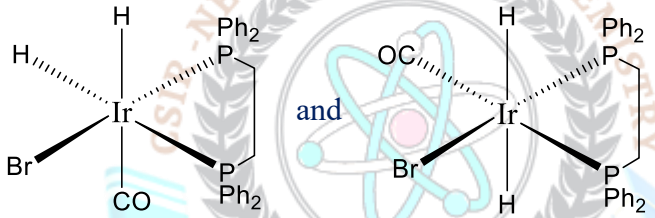
(c) 

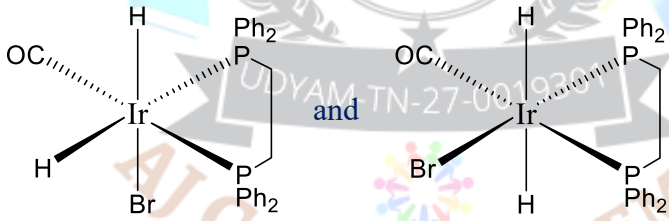
(d) 

114. **Oxidative addition of H_2 to the complex [(dppe)Ir(CO)Br] (dppe=Diphenylphosphinoethane) forms a complex (X), which rearranges to its isomer (Y). The correct structures of (X) and (Y) are, respectively**

(a) 

(b) 

(c) 

(d) 

115. **The treatment of $[HCo(CO)_4]$ with H_2O produces**

(a) $[(H_2)Co(CO)_4]^+$and OH^- (b) H_3O^+ and $[Co(CO)_4]^-$

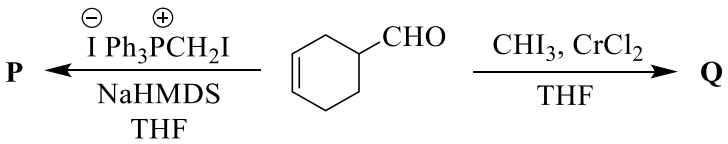
(c) $[(H)_2Co(OH)(CO)_3]$ and CO (d) $[HCo(CO)_3(H_2O)]$ and CO

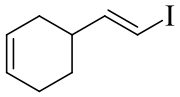
116. **The correct arrangement of the oxo-species (i) $Fe^{IV}O$, (ii) $Mo^{VI}O_2$ and (iii) $W^{VI}O_2$, in the order of their increasing O-atom transfer property is**

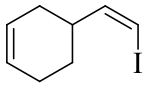
(a) (iii) < (ii) < (i) (b) (i) < (ii) < (iii)

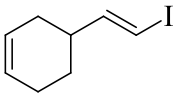
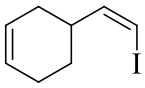
(c) (i) < (iii) < (ii) (d) (ii) < (iii) < (i)

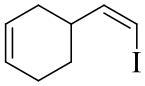
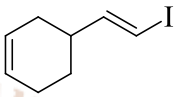
117. **The major products P and Q in the following reactions are**



(a) P = Q = 

(b) P = Q = 

(c) P =  Q = 

(d) P =  Q = 

118. For a conventional d.c.polarography match items in Column-I with those in Column-II

	Column-I		Column-II
i	Polarographic wave	p.	Concentration
ii	Migration Current	q.	$E_{1/2}$
iii	Diffusion current	r.	Supporting electrolyte
iv	Dropping Mercury Electrode	s.	Amalgam
v	Mercury anode	t.	Reduction

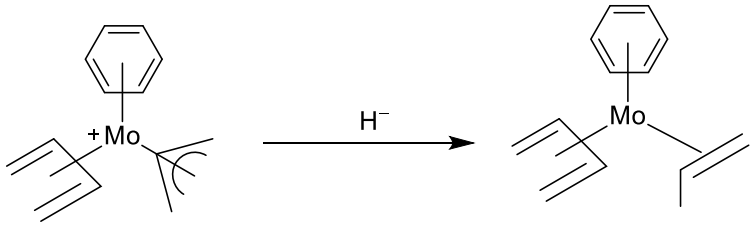
	i		ii		iii		iv		v
(a)	q	;	r	;	p	;	t	;	s
(b)	s	;	r	;	p	;	t	;	q
(c)	q	;	p	;	r	;	t	;	s
(d)	p	;	s	;	t	;	r	;	q

119. Which pair of electronic configurations will prefer tetragonally compressed octahedral geometry?

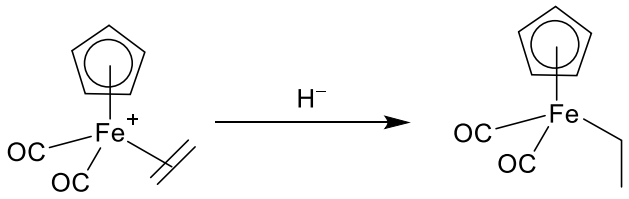
(a) d^1 and d^2 (b) d^2 and d^5 (LS) (c) d^2 and d^6 (HS) (d) d^1 and d^4 (LS)

120. Among the following, the reaction which is NOT feasible is

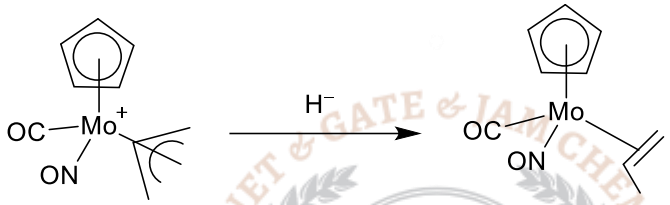
(a)



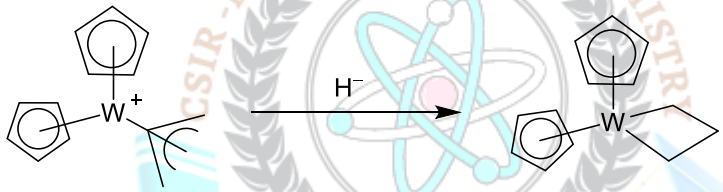
(b)



(c)



(d)



Answer Key

PART - B

Q.No	Ans
21.	c
22.	b
23.	d
24.	c
25.	b
26.	b
27.	b
28.	b
29.	a
30.	a

Q.No	Ans
31.	a
32.	d
33.	a
34.	a
35.	a
36.	b
37.	c
38.	a
39.	a
40.	b

Q.No	Ans
41.	d
42.	b
43.	b
44.	c
45.	c
46.	b
47.	a
48.	a
49.	c
50.	d

Q.No	Ans
51.	b
52.	a
53.	b
54.	a
55.	b
56.	d
57.	d
58.	b
59.	c
60.	a

PART - C

Q.No	Ans
61.	b
62.	b
63.	d
64.	a
65.	a
66.	b
67.	d
68.	d
69.	c
70.	b
71.	c
72.	c
73.	a
74.	d
75.	a

Q.No	Ans
76.	a
77.	b
78.	b
79.	c
80.	a
81.	b
82.	b
83.	b
84.	d
85.	c
86.	d
87.	c
88.	d
89.	a
90.	a

Q.No	Ans
91.	b
92.	b
93.	d
94.	d
95.	d
96.	d
97.	a
98.	a
99.	b
100.	b
101.	a
102.	b
103.	a
104.	a
105.	b

Q.No	Ans
106.	c
107.	d
108.	b
109.	b
110.	d
111.	d
112.	a
113.	b
114.	b
115.	b
116.	a
117.	d
118.	a
119.	d
120.	a